

Power, energy and electricity bills

Grade 8 science (Year 9 · Class 8) · Lab answers

Model answers use the sample table. Your own values will differ a little, but the trends should match: power rises with voltage, and it rises faster than the voltage because the filament heats up.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS3

Question 1 Power at each setting

2.0 V: 0.40 W

4.0 V: 1.24 W

6.0 V: 2.28 W

8.0 V: 3.52 W

10.0 V: 4.80 W

12.0 V: **6.24 W**

The 12 V value is close to the lamp's 6 W rating.

Question 2 Graph of power against voltage

The points rise in a curve that gets steeper: the power increases by 0.84 W between 2 and 4 V but by 1.44 W between 10 and 12 V. **Power rises faster than the voltage**, so the graph is not a straight line.

Question 3 Energy in one minute

$E = P \times t = 6.24 \text{ W} \times 60 \text{ s} = 374.4 \text{ J}$, so **374 J** to 3 significant figures.

Question 4 Running cost

$E = 0.00624 \text{ kW} \times 5 \text{ h} = 0.0312 \text{ kWh}$. Cost = $0.0312 \times 20 \text{ p} = 0.624 \text{ p}$, so **about 0.62 p**.

Question 5 Voltage and current ratios

I rose from 0.20 A to 0.52 A, a factor of $0.52 \div 0.20 = \mathbf{2.6}$. The filament gets hotter and hotter, and a hot filament lets less current through for the same voltage, so the current rises more slowly than the voltage.

Question 6 Uncertainty

Current: $0.01 \div 0.31 = 3.2 \%$. Voltage: $0.1 \div 4.0 = 2.5 \%$. Add: $3.2 + 2.5 = 5.7 \%$, so $P = 1.24 \text{ W} \pm \mathbf{5.7 \%}$ (**about $\pm 0.07 \text{ W}$**).

Question 7 Better readings

Switch the lamp off between readings so the filament always starts cold, and read the meters straight away; also use meters with a finer scale. **Any two sensible changes** earn full credit.